View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Digital Repository @ Iowa State University

Iowa State University
Digital Repository

Aperiodic 2018 ("9th Conference on Aperiodic Crystals")

Aperiodic 2018 Abstracts

Analysis of the Graphene-Metal Coincidence Lattice for Ruthenium Islands Embedded in the Surface of Graphite

Patricia A. Thiel
Iowa State University and Ames Laboratory, thiel@ameslab.gov

Ann Lii-Rosales
Iowa State University and Ames Laboratory, ylii@iastate.edu

Michael C. Tringides
Iowa State University and Ames Laboratory, tringides@ameslab.gov

Ka Man Yu
Hong Kong University of Science and Technology

Michael Altman
Hong Kong University of Science and Technology

Follow this and additional works at: https://lib.dr.iastate.edu/aperiodic2018

Part of the Chemistry Commons, and the Materials Science and Engineering Commons

Thiel, Patricia A.; Lii-Rosales, Ann; Tringides, Michael C.; Yu, Ka Man; and Altman, Michael, "Analysis of the Graphene-Metal Coincidence Lattice for Ruthenium Islands Embedded in the Surface of Graphite" (2018). *Aperiodic 2018 ("9th Conference on Aperiodic Crystals")*. 21.
https://lib.dr.iastate.edu/aperiodic2018/2018/abstracts/21

This Poster Presentation is brought to you for free and open access by the Conferences and Symposia at Iowa State University Digital Repository. It has been accepted for inclusion in Aperiodic 2018 ("9th Conference on Aperiodic Crystals") by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.

Analysis of the Graphene-Metal Coincidence Lattice for Ruthenium Islands Embedded in the Surface of Graphite

Patricia A. Thiel,[1] Ann Lii-Rosales,[1] Michael C. Tringides,[1] Ka Man Yu[2], and Michael Altman[2]

[1] Ames Laboratory and Iowa State University, Department of Chemistry, Department of Materials Science & Engineering, and Department of Physics & Astronomy, Ames Iowa USA

[2] Department of Physics, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong

thiel@ameslab.gov

The growth of graphene on metal substrates has been studied extensively.[1,2] Recently, we have shown that it is possible to do the reverse, i.e. to grow metal islands that burrow beneath graphene sheet(s) on the surface of graphite.[3,4] Such buried islands could be useful in applications such as catalysis, magnetism, and tribology, especially since they may be protected from surface oxidation and stabilized against coarsening, yet remain surface-accessible. We have found that Cu, Ru, Pt, Dy, and Gd can form buried islands, if two steps are included in the synthetic strategy: (i) defects are introduced into the graphite surface via ion bombardment, to serve as entry portals to the subsurface region; and (ii) the defect-rich graphite surface is held at substantially elevated temperature while metal is deposited from the vapor phase. Characterization via x-ray photoelectron spectroscopy shows that the buried islands are metallic, while scanning tunnelling microscopy (STM) reveals their morphology and atomic features. However, in general it is difficult to find other techniques or approaches that are suitable for interrogating these islands because of their small size (typically a few tens of nm in diameter) and low coverage, and the crystallographic heterogeneity of the substrate.

For three of the metals that form buried islands—Ru, Dy, and Gd—the topmost graphene sheet forms a large coincidence lattice (moiré) with the underlying metal, due to lattice mismatch between graphene and metal. Such moirés are already well-known for graphene grown on certain bulk metal surfaces, including Ru(0001).[1-3] Their existence on top of the buried islands provides another tool for characterizing the buried metal.

Specifically, three quantities can be measured with STM: moiré spacing or coincidence lattice constant (a_c), graphite lattice spacing (a_g), and relative orientation (θ_c) of the coincidence lattice with respect to the graphite lattice. Then the metal lattice constant, a_m, and the relative orientation of the metal lattice with respect to the graphite lattice, θ_m, can be determined. Results for Ru will be discussed in detail.

1. M. Batzill, *Surf. Sci. Rep.* **67**, (2012) 83-115.
2. J. Wintterlin and M.-L. Bocquet, *Surf. Sci.* **603**, (2009) 1841-1852.
3. Y. Zhou, A. Lii-Rosales, M. Kim, M. Wallingford, D. Jing, M. C. Tringides, C.-Z. Wang and P. A. Thiel, *Carbon* **127**, (2018) 305-311.

4. A. Lii-Rosales, Y. Han, J. W. Evans, D. Jing, Y. Zhou, M. C. Tringides, M. Kim, C. Z. Wang and P. A. Thiel, *J. Phys. Chem. C* **122**, (2018) 4454-446